

WHAT IS CLAIMED IS:

1. A hale-machining method comprising the steps of:

mounting a rotary table rotatably around a first rotating axis;

5 mounting a rotary base on said rotary table rotatably around a second rotating axis perpendicular to said first axis;

mounting a tool holder on said rotary base rotatably around a third rotating axis perpendicular to both of said first rotating axis and said second rotating axis;

10 setting a haling tool on said tool holder in such a manner that a cutting point of said haling tool is substantially coincided with an intersection of said first rotating axis, said second rotating axis and said third rotating axis;

straightly moving said tool holder and a workpiece table holding a workpiece relatively along a machined surface of said workpiece in three perpendicular axes including an axis parallel to said first rotating axis;

15 rotating said rotary table and said rotary base in such a manner that a tool axis direction of said haling tool is substantially coincided with a normal direction of said machined surface; and

rotating said tool holder in such a manner that a front rake surface of said haling tool is substantially directed in perpendicular to a feeding direction of said haling tool.

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2. A hale-machining method according to Claim 1, wherein said setting is performed by a fine position adjustment mechanism.

3. A hale-machining apparatus comprising:

25 a rotary table mounted rotatably around a first rotating axis by a first rotary driving device;

a rotary base mounted on said rotary table rotatably around a second rotating axis perpendicular to said first rotating axis by a second rotary driving device;

a tool holder mounted on said rotary base rotatably around a third rotating axis perpendicular to said first rotating axis and said second rotating axis by a third rotary driving device;

5 a haling tool set on said tool holder in such a manner that a cutting point of said haling tool is substantially coincided with an intersection of said first rotating axis, said second rotating axis and said third rotating axis;

three straight movement devices moving relatively said tool holder and a workpiece table along a machined surface of said workpiece in three perpendicular axes including an axis parallel to said first rotating axis;

10 said first and second rotary driving devices rotate said rotary table and said rotary base respectively in such a manner that a tool axis direction of said haling tool is substantially coincided with a normal direction of said machined surface;

said third rotary driving device rotate said tool holder in such a manner that a front rake surface of said haling tool is substantially directed in perpendicular to a feeding direction of said haling tool; and

15 a controller controlling said first rotary driving device, said second rotary driving device, said third rotary driving device and said three straight movement devices in order that said cutting point is moved along said desired machined surface.

20 4. A hale-machining apparatus according to Claim 3, further comprising:
a fine position adjustment mechanism adjusting said rotary base and said tool holder to set said haling tool on said tool holder in said such manner that said cutting point of said haling tool is substantially coincided with said intersection of said first rotating axis, said second rotating axis and said third rotating axis.

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5. A hale-machining apparatus according to Claim 4, wherein said three straight movement devices including:

a Y-axis straight movement device moving straightly said Y-axis slide table on a bed along a Y-axis direction;

said Y-axis is parallel to said first rotating axis;

said rotary table is mounted on said Y-axis slide table rotatably around said first rotating axis; and

5 a X-axis and a Z-axis straight movement devices moving straightly said workpiece table on said bed along a X-axis direction and a Z-axis direction respectively, said X-axis, said Y-axis and said Z-axis are constructed a three perpendicular axes.

10 6. A hole-machining apparatus according to any one of Claim 3 to Claim 5, further comprising:

a workpiece spindle mounted on said workpiece table rotatably by a fourth rotary driving apparatus around a fourth rotating axis perpendicular to said first rotating axis, said workpiece spindle holds said workpiece on the end thereof.